1886MNRAS..46..342F

Introduction to a Catalogue of the Colours of 1,730 *Stars.*
By W. S. Franks.

The observations detailed in the Catalogue of Star Colours, herewith presented to the Society,[*] were commenced on Oct. 31, 1884, and continued until March 10, 1886. Two telescopes were employed, both of them Newtonian reflectors, and equatorially mounted—the specula, by Calver, of 11¼-inch and 5¼-inch aperture, with foci of 80 inches and 40 inches respectively. The smaller instrument was reserved for stars between +54° and the Pole, which the larger telescope, from its peculiar style of mounting, could not reach. The eyepieces used were of the "Kellner" construction, giving powers of 90 and 200 on the 11¼-inch, 45 and 100 on the 5¼-inch; the lower power had a field of 40′ on the former, and 1° on the latter instrument. The higher power was only used for *double* stars. The magnitudes provisionally employed were derived from Heis, and, on the whole, they were found to be fairly accurate. A few obvious discrepancies were, however, met with, and duly recorded in the column headed "Remarks"; though particular attention to magnitude determinations was scarcely thought of, after the elaborate photometric researches so recently undertaken by Professors Pickering and Pritchard. All stars down to the 6–5 magnitude of the *Atlas Cœlestis Novus* (between − 20° and +90°) were examined, besides a few others of 6 magnitude, which were added during the prosecution of the work, being, in most cases, such as were in the immediate vicinity of the objects under examination. The constellation boundaries adopted were also from Heis, and in such instances where they differed from those of the B.A.C., a note to that effect was inserted under "Remarks." Every star common to the present catalogue and the previous one (1877-8) has been compared, and where any serious difference was detected the same was duly entered in its proper place. Some of the violent discordances alluded to may probably be due to defective identification, the 1877-8 series having been taken directly from the atlases of Proctor and the S.D.U.K., and the finder as often used in the search as the circles. But, in the present list, every star has been separately identified by circle readings; and it is therefore likely to be the more trustworthy of the two series. On the whole, however—and considering that the two sets were made with telescopes of different construction, with a wide difference in aperture—the old and new observations are fairly accordant, and within the usual limit of error.

In connection with the subject of star colours it may be worth remark that many stars were found to be distinctly *yellower* in twilight than on a dark sky; also that slight fog or haze had the effect of intensifying the yellow tints, especially, of course, towards the horizon. And, further, when collating the

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[*] The Catalogue is placed in the Library.

1886MNRAS..46..342F

present observations with those made in 1877–8 (Catalogue of 3,890 Stars) a systematic difference was clearly manifested, inasmuch as the $11\frac{1}{4}$-inch reflector made most objects with a yellow or orange tint distinctly *paler* than they were seen with the 5-inch achromatic—apparently due to the difference in the light-grasping power of the two telescopes, rather than to their different construction. From a careful series of comparisons which I made some years ago, between a refractor and reflector mounted side by side, with the apertures arranged so as to be precisely equivalent, I do not believe there is any appreciable difference between the colour results given by a reflector and a well-achromatised refractor of similar light-grasping power. On comparing the percentages given in the Appendix to the Catalogue (Table 2), it will be seen that, out of a total of 52 constellations, 42 show a *higher* percentage of "white" stars, and 36 a *lower* percentage of "orange" stars, for the 1884–6 than for the 1877–8 series. This and the preceding facts seem to point to the conclusion that the *colour* of stellar light is affected, to a certain extent, by its intrinsic *brightness* also. And another circumstance, which does not appear to have hitherto attracted attention, tends to confirm this view. It is that those constellations having many *bright* stars are, as a rule, remarkable for their high percentage of "white"; whilst in those constellations where there are many *small* stars, and relatively few bright ones, the "yellow" and "orange" tints are most abundantly found. The question of colour distribution in the sidereal heavens has, so far, received but scant attention from astronomers, notwithstanding the interesting nature of the inquiry, and that it might be made to yield important evidence respecting the constitution and structure of the stellar universe. It is a fact worthy of remark that most of the constellations with a high percentage of *white* stars, such as *Cassiopeia*, *Perseus*, *Taurus*, *Orion*, *Scorpio*, *Lyra*, &c., are associated with the galaxy. The late Prebendary Webb had noticed the absence of coloured stars as regards *Taurus*; and Padre Secchi, from spectroscopic observations, found that stars with spectra of the first (Vega) type prevailed in *Lyra*, *Taurus*, and *Orion*. The latter observer also remarked that the second (Aldebaran) type was abundant in *Cetus*, *Cepheus*, *Draco*, *Eridanus*, &c.; but the last-named constellation is, according to my observations in 1877–8 and 1884–6, rather remarkable for "white" than "yellow" stars. The *yellow* and *orange* coloured stars appear to be generally most plentiful in large straggling constellations, such as *Cetus*, *Pisces*, *Hydra*, *Leo*, *Virgo*, *Boötes*, *Draco*, *Aquila*, &c.; whilst the rich compact asterisms are distinguished for their number of *white* stars. Beyond this it does not seem possible at present to indicate any general law that governs the distribution of stellar colours, though it is much to be desired that with a better means of registering star tints than is afforded by mere eye-estimation, some effort should be made in the future to throw light upon this interesting though obscure

1886MNRAS..46..342F

point. As illustrating the fact, previously referred to, of the systematic discordancy between the colour estimates of 1877–8 and 1884–6, the Appendix shows that the *mean* percentage of white, yellow, and orange stars is as follows:—

55·2 white, 35·2 yellow, 9·6 orange, from 1,744 stars in 1884–6 catalogue.
48·6 ,, 36·8 ,, 14·6 ,, ,, 1,641 ,, ,, 1877–8 {which are common to both lists.
46·0 ,, 38·1 ,, 15·9 ,, ,, 3,816 ,, ,, 1877–8 catalogue.

As the larger number of stars in the 1877–8 series confirms the smaller number common to both lists, it is evident that, in any future observations the *aperture* of the telescope will have to be considered as a modifying factor in the final result.

A few words of explanation will suffice respecting the arrangement of the present catalogue. Instead of the usual arbitrary order in R.A., which could give but little idea of the grouping of colours in particular regions of the heavens, the stars are arranged in *constellations*, according to the "Index-plan;" from which it will be seen that they are divided into twelve groups, each group commencing at the southern limit and ending at the most northern. This was done, in the first place, for convenience in observing; and it has been retained because it seemed an improvement over the older plan. No difficulty need arise in finding any required object, since the constellation page is there given, and the stars in each constellation are in R.A. order. In addition to the "Symbols and Abbreviations" given on the same page as the Index-plan, a few others have been employed, as follows: "brt."=bright; "wh."=white; "blsh."=bluish; "grnsh."=greenish; "yelsh."=yellowish; "yel."=yellow; "or."=orange. And the "Explanation of Terms used in designating Star Colours" may be of service in giving a more precise definition of the intended meaning. Column I. of the catalogue gives the *name* of star; column II. its *number* in the "British Association Catalogue;" columns III. and IV. the *R.A.* and *Decl.* for epoch 1880 (these are approximate merely, but quite sufficient for identification); column V. gives the *magnitude*, from Heis' "Catalogus;" column VI. the *colour*, as observed with the $11\frac{1}{4}$-inch or the $5\frac{1}{4}$-inch telescope; column VII. the *date* of observation, together with *remarks*—the magnitudes in this column, when following a "double" or "triple" star, are from Struve's "Mensuræ Micrometricæ."

The positions of 1,730 stars are given in the catalogue, but the total number of stars included is 1,893, the balance being due to the *comites* of multiple stars. Some 72 stars, chiefly from Bode and Lalande, appear in this catalogue for the first time; all the others are contained in my former list of 3,890 stars (1877–8). The "double" stars were, as a whole, observed before the others; this being part of a previously arranged survey of all the sidereal portion of Webb's "Celestial Objects."

1886MNRAS..46..342F

As considerable care was devoted to these double stars it was thought advisable to include the *colours* of their *comites* in the present list—at least, such as were above 9 mag.

The "Appendix" contains a table, giving an analysis of all the colours of the 1,893 stars (reproduced at the end of this paper); and a second table, in which the percentage of "white," "yellow," and "orange" stars only, is given. For the purpose of comparison, the percentage results of the stars common to the catalogues of 1877–8 and 1884–6, and also those obtained from the whole of the stars in the former catalogue, are appended. An attempt has been made on the map which accompanies the catalogue to give a graphic delineation of the manner in which the white, yellow, and orange stars are distributed in the N. hemisphere; it includes about 1,400 stars.

Analysis of the Colours of Stars contained in the Catalogue
(*Table I., Appendix*).

Constellation.	White.	Yellow.	Orange.	Red.	Green.	Blue.	Purple.	Others.	Total.
Cetus	23	18	4	—	—	1	2	—	48
Pisces	15	28	6	2	—	1	—	—	52
Andromeda	21	15	4	—	1	—	—	—	41
Cassiopeia	25	15	2	1	—	2		1	48
Eridanus	20	10	5	—	1	—	—	—	36
Aries	26	10	—	1	—	1	1	—	39
Triangula	7	6	—	—	1	—	—	—	14
Taurus	50	13	4	—	1	3	4	—	75
Perseus	31	14	5	—	—	2	1	—	53
Lepus	7	3	—	—	1	—	—	—	11
Orion	44	10	4	1	—	6	2	—	67
Auriga	18	13	5	—	—	1	3	—	40
Camelus	25	10	4	—	—	3	1	—	43
Canis Major	7	4	2	—	1	—	—	—	14
Monoceros	24	8	3	—	—	1	1	1	38
Canis Minor	5	4	1	—	—	2	—	—	12
Gemini	21	15	3	—	—	1	3	—	43
Lynx	12	5	—	1	—	—	3	—	21
Argo Navis	6	—	1	—	—	1	—	—	8
Hydra	10	9	4	2	—	—	1	—	26
Cancer	16	13	3	—	1	2	—	—	35
Leo Minor	9	7	2	—	—	—	—	—	18
Sextans	6	1	—	—	—	—	—	—	7
Crater	3	5	1	—	—	—	—	—	9
Leo	25	20	14	1	—	2	4	1	67

1886MNRAS..46..342F

Constellation.	White.	Yellow.	Orange.	Red.	Green.	Blue.	Purple.	Others.	Total.
Ursa Major	40	27	4	—	1	2	2	—	76
Corvus	5	1	—	—	—	—	1	—	7
Virgo	22	20	3	—	—	1	—	—	46
Coma Berenices	10	12	2	—	—	—	3	—	27
Canes Venatici	12	7	7	—	—	1	—	1	28
Libra	8	5	—	—	—	—	—	—	13
Boötes	29	23	4	—	—	1	6	—	63
Corona Borealis	10	9	2	—	—	1	1	—	23
Ursa Minor	8	7	1	—	—	—	—	—	16
Scorpio	7	2	—	—	—	1	1	—	11
Serpens	16	12	2	—	—	—	—	—	30
Ophiuchus	23	14	2	—	—	—	1	—	40
Hercules	47	23	12	—	2	—	1	—	85
Draco	40	32	9	—	—	4	3	—	88
Sagittarius	5	3	—	—	—	—	—	—	8
Aquila	28	22	3	—	—	—	1	—	54
Sagitta	3	5	1	—	—	1	—	—	1
Lyra	16	10	1	1	—	2	—	1	31
Capricornus	10	7	3	—	—	2	—	—	22
Delphinus	8	5	—	—	1	—	1	—	15
Equuleus	1	6	—	—	1	1	1	—	10
Vulpecula	16	9	2	—	—	1	—	—	28
Cygnus	45	29	10	—	3	6	3	2	98
Aquarius	29	17	4	—	—	3	2	—	55
Pegasus	28	30	11	—	—	—	1	—	70
Lacerta	12	3	5	—	—	—	—	—	20
Cepheus	28	18	3	—	—	3	2	—	54
Grand Total	962	614	168	10	15	59	58	7	1,893

Note on the Radiation of Meteors. By W. F. Denning.

In a short paper on the Biela meteors (*Monthly Notices*, Jan. 1886, p. 118) Mr. Proctor remarks that the diffuse character of the radiation "appears unquestionably due to changes of direction caused by atmospheric resistance," and then hastily assumes that a radiant-area of two degrees diameter cannot "safely be assigned to meteors having the so-called stationary radiants."

But Mr. Proctor quite misses the fact that these meteors of Biela's comet enter the atmosphere at the rate of only about eleven miles per second, while the apparent velocities of the very great majority of the other known meteor streams must average